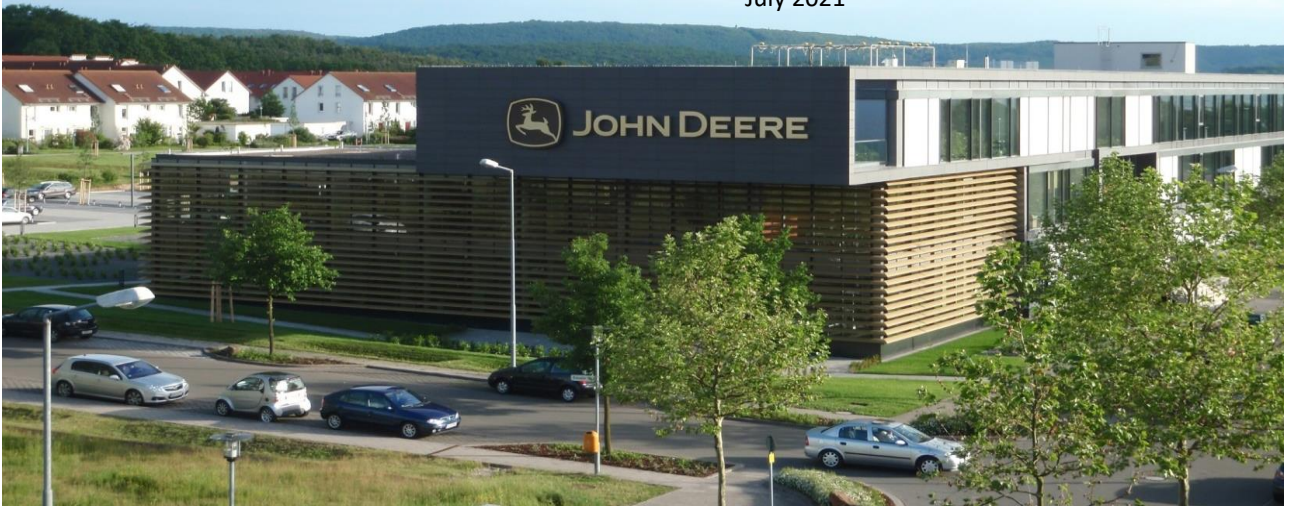




# One Vision for Ag Robotics

Prof. Dr.-Ing. Peter Pickel  
July 2021



1

## ROBOT - DEFINITION

Common idea:	<b>Manlike</b> machine based on Josef Čapek (1920) ... today: „Androids“
Wikipedia (en):	A robot is a machine — especially one <b>programmable</b> by a computer — capable of carrying out a complex series of actions automatically (quotation Oxford English Dict.)
Wikipedia (de):	Ein Roboter ist eine technische Apparatur, die üblicherweise dazu dient, <b>dem Menschen</b> häufig wiederkehrende mechanische <b>Arbeit abzunehmen</b> . Roboter können sowohl <b>ortsfeste als auch mobile</b> Maschinen sein und werden von Computerprogrammen gesteuert.



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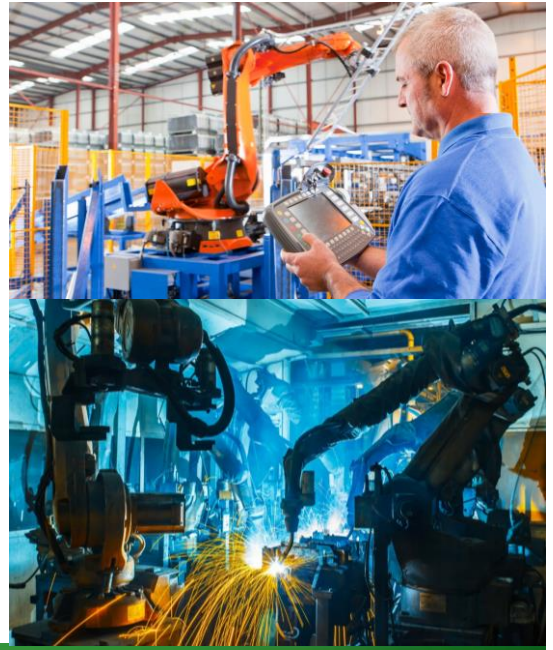
## ROBOT - DEFINITION

VDI-Richtlinie 2860:

Industrieroboter sind universell einsetzbare Bewegungsautomaten mit mehreren Achsen, deren Bewegungen hinsichtlich Bewegungsfolge und Wegen bzw. Winkeln frei (d. h. ohne mechanischen bzw. menschlichen Eingriff) programmierbar und gegebenenfalls sensorgeführt sind. Sie sind mit Greifern, Werkzeugen oder anderen Fertigungsmitteln ausrüstbar und können Handhabungs- und/oder Fertigungsaufgaben ausführen

Robotic Industries Association:

A robot is a reprogrammable, multifunctional manipulator designed to move material, parts, tools or specialized devices through variable programmed motions for the performance of a **variety of tasks**



## AUTONOMY LEVEL 3<sup>\*)</sup>

Signal accuracy

Satellite only	± 2 m
w/ Correction SF1	± 15 cm
w/ Correction SF3	± 3 cm
w/ Local base RTK	± 2,5 cm (repeatable)

\*) SAE J3016

## WHY DON'T WE HAVE AUTONOMOUS MACHINES?



⇒ **Because of safety/legal issues**

- *But driverless machines are the safest machines from the driver's perspective*
- *But operational setting is endangered seriously*

**Change of paradigm expected**

⇒ **Because of a lack of functional safety (functional stability)**

- *Example: So long as there might be a pick-up (trailer) plugging a (service) person will be needed*

**Automation will have to „attack“ the gap of functional stability  
(e.g. by disturbance management systems or partially zero defect operation)**

## ELECTRIFICATION - KEY ENABLING TECHNOLOGY

- **Efficiency**
- **Power density**
- **Controllability and dynamic response behavior**

# JOHN DEERE

# EXACTEMERGE

### Electric system characteristics

- 48 V PTO generator or high power AEF connector
- 2 servo-motors per row unit



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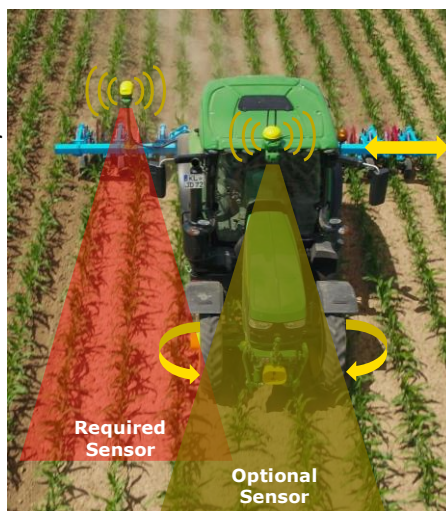
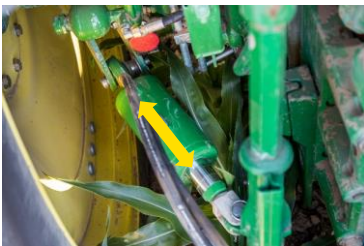


7

## TRACTOR INTEGRATED ACTIVE IMPLEMENT GUIDANCE

Steering Tractor & Cultivator precisely

- Detecting crop rows
- Calculating offset to plants
- Guiding tractor & cultivator



- Maximize weeding success
- Minimize plant losses



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8

# AGRILOC



# ALTERNATIVES



Herbicide system (Blueriver T./John Deere)



## ELECTRIFICATION - KEY ENABLING TECHNOLOGY

- Efficiency
- Power density
- Controllability and dynamic response behavior
- Using renewable energy

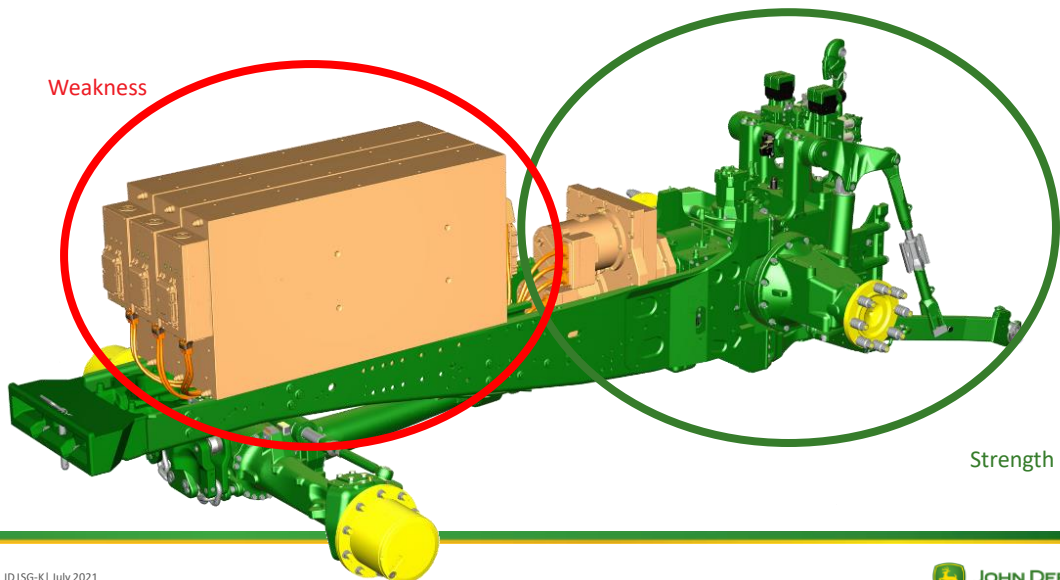
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12

## SESAM

Battery Electric Tractor Exhibit for SIMA 2017



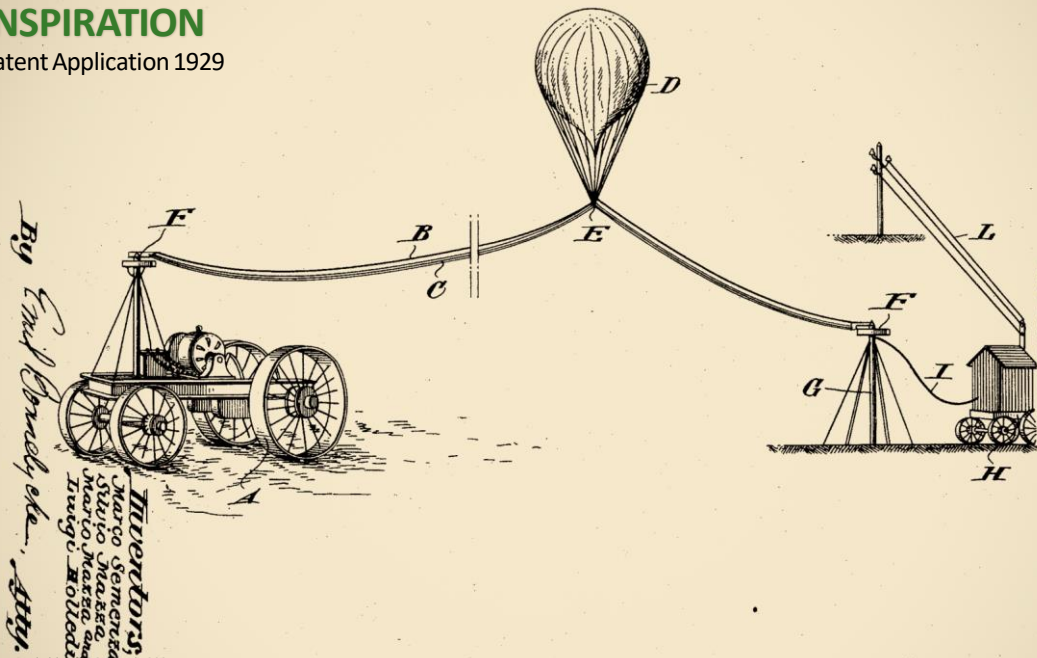
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16

# INSPIRATION

Patent Application 1929



Oct. 29, 1929.

M. SEMENZA ET AL

1,733,242

SYSTEM OF ELECTRIC PLOWING BY DIRECT TRACTION

Filed Dec. 19, 1927

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[M. Semenza et al., System of Electric Plowing By Direct Traction, Pat.Nr. 241243, 1929]

17

# DEVELOPMENT PLATFORM

SESAM Battery Tractor




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18



## Overcoming Limits of Onboard Batteries

Corner Stones	
Machine Performance	200%
Power Density	200%
Machine Cost	50%
Operating Cost	50%
Applicability of Renewable Power	up to 100%
Supports different stationary power sources	Power grid Battery Generator Fuel cell

Supported by:  Bundesministerium für Wirtschaft und Energie

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19

### Field Swarm Unit Concept

Source: Pfaffmann

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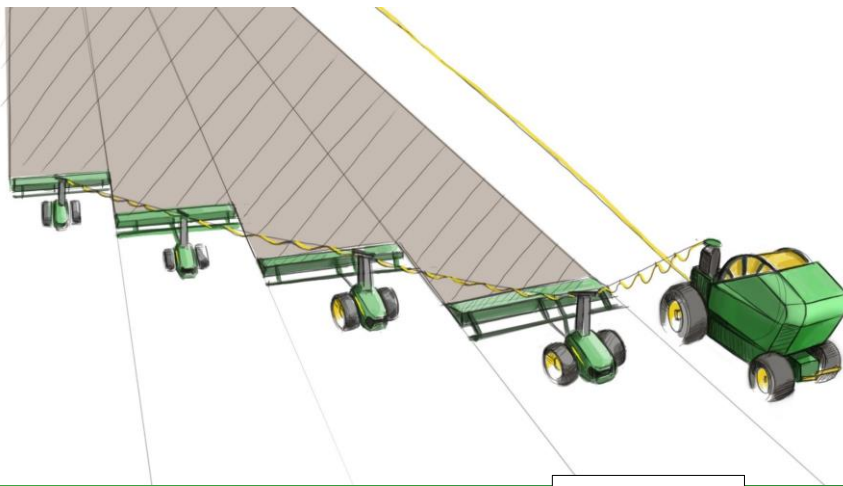


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24

### John Deere Field Swarm Vision



Source: Pfaffmann

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26

